Radiated & Conducted Emissions Test Report

Product Tested:

Name: Emergency Alert System
Model: Twister E.A.S.

Prepared for:

Cadco Systems, Inc.
2363 Merritt Drive
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Prepared by:

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REPORT PREPARED BY: Barbara Reed
RheinTexas, Inc.

Report Number: 9808021-1
Issue Date: August 31, 1998

NVLAP *Accredited by the National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under laboratory code 200245-0*

EMC Engineering and Testing Services

Radiated & Conducted Emissions Conformance Statement

Report Number: 9808021-1
Product Name: Emergency Alert System
Model: Twister E. A. S.

We, the undersigned, hereby state that the proper standards and procedures were followed as detailed in this test record. Furthermore, we attest that the data contained within this report is accurate and concise within the bounds of the standards and our company procedures.

Lonnie Smoots
EMC Technician

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. There were no modifications made to the equipment in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI 63.4 1992 test methodology.

Signature: Michael Cantwell

Date: August 31, 1998

Full Name: Michael Cantwell, PE

Location: Plano, Texas

Title: NARTE EMC Engineer (EMC-002019-NE)
Signatory for NVLAP

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1. Executive Summary

The following report for EMC compliance of a Class B Information Technology Equipment (ITE) is prepared on behalf of Cadco Systems, Inc. in accordance with the rules of the Federal Communications Commission (47 CFR 15) and the EMC Directive (89/336/EEC as amended by 91/31/EEC) of the European Union.

This report covers testing for the Emergency Alarm System and all testing was performed on 21ST of August.

All equipment configurations and measurements contained in this report were performed in accordance with the revision of the standards listed in this report. Also, the instrumentation and facilities utilized for the measurements conform with all appropriate standards. Calibration checks are performed yearly on the instruments by a local calibration lab, with traceability to the National Institute of Standards and Technology (NIST).

All radiated and conducted emission measurements are performed manually at RheinTexas, Inc. The radiated emission measurements required by the rules were performed on a 10m open area test site (OATS) maintained by RheinTexas, Inc., 1701 East Plano Parkway, Suite 150, Plano, Texas 75074, USA. Complete site descriptions and site attenuation measurement data are maintained at the test facility and can be made available upon request. The Power Line Conducted Emission Measurements were performed in a shielded enclosure also located at the same facility. The radiated and conducted measurement sites have been listed with the Federal Communications Commission (FCC).

1.1 Modifications to EUT

There were no modifications made.

1.2 Special Accessories

There were no special accessories found necessary as a result of this testing.

2. Test Facility

The open area test site used to collect the emissions data is located at RheinTexas, Inc., 1717 Capital Avenue, Plano, Texas 75074. The site utilized for testing was 1NE. This site has been fully described in reports submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing per ANSI C63.4 1992.

3. EUT Configuration

3.1 Technical Description

Cadco Systems' Twister Emergency Alert System (TEAS) is designed to provide the user with a simple, low cost, quality solution to the FCC requirement to monitor two audio sources for local, state, and national emergency messages. Cadco has designed the TEAS to fulfill CFR 47, Part 11 requirements while giving the user the functionality necessary to meet local and regional needs.

The TEAS uses a front panel LCD and associated keypad to provide easy to use password protested menus for user/site specific input, alert statusing, message sequencing, and alert activation.

The TEAS monitors two assigned audio inputs. Either the internal National Weather Service Receiver and the internal broadcast band FM receiver may be used for monitoring assignments of and other two audio sources may be connected to the rear panel and used in lieu of the internal receivers. EAS messages are received through the audio inputs, public switched telephone interface, or serial port.

The received audio FSK tones are converted to digital form using a FSK Decoder. The transmitted digital signals representing the EAS codes are converted to analog using a FSK Encoder.

When an EAS message is received it is checked for validity. The microprocessor determines the message validity by comparing repetitive messages and looks for a successful two out of three compare ratio. Invalid messages, those that do not match two out of three times, are discarded without further action. The messages are also compared to FCC guidelines for valid messages.

Valid messages are compared with previously received messages that still have active timer periods. Duplicate messages are discarded. New messages are compared with a list of pre-selected header codes and are either stored for manual processing, automatic delay, or immediately relayed automatically, as determined by the pre-selected header parameters.

The audio portion of the EAS message is digitized and stored ion an internal digital voice storage. The audio is also available at the front monitor speaker and at the back panel audio out.

A base band video message may be relayed. Internal video sync detector circuitry constantly monitors the back panel video input plug and will automatically up convert to IF and pass on any video messages.

Expanded text messages can be compiled and stored internally for automatic relay. Using an internal character generator and IF modulator, text messages are easily transported from the TEAS to a cable headend. Text messages may be compiled using the front keypad, LCD, and program menus. The public switched telephone interface, and /or the RS-232 I/O port.

When an alert is transmitted, the TEAS places the EAS FSK data tones, two tone attention signal, audio message, expanded text message to the character generator/IF modulator section. The output of the IF modulator is a properly sequenced EAS alert modulated at 45.75 MHz, ready for up converting for further propagation.

Audio sources are either stored or live. Live sources are the front panel microphone, two monitored audio source assignments, or the public switched telephone network interface. There are two stored sources. One source stores up two minutes of audio from the two monitored assignments or the microphone. When a message is relayed manual, the user can specify which source the audio will come from.

Assigned audio sources are continuously monitored. Any EAN event will automatically override any other alert.

3.2 *Test Configuration(s)*

PU = Power Unshielded
PS = Power Shielded
DU = Data Unshielded
DS = Data Shielded

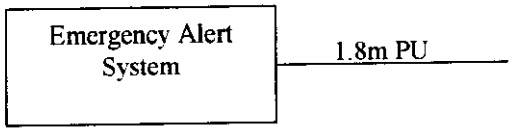

Figure 1 - Block Diagram of System Configuration

The system was configured for testing in a typical fashion (as a customer would normally use it). Antenna connections were terminated into 75Ω.

A list of the equipment under test (EUT) and it's support equipment is found below.

Table 1 - Components in Block Diagram

Description	Manufacturer	Model	Serial No	FCC I.D.
Emergency Alert System (EUT)	Cadco Systems, Inc.	Twister	None	None

3.3 Exercise Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The software exercised the Emergency Alert System by providing emergency tones at frequent intervals.

3.4 Mode of Operation

The EUT was operated with a test software that generated emergency tones at frequent intervals.

3.5 Photos of EUT

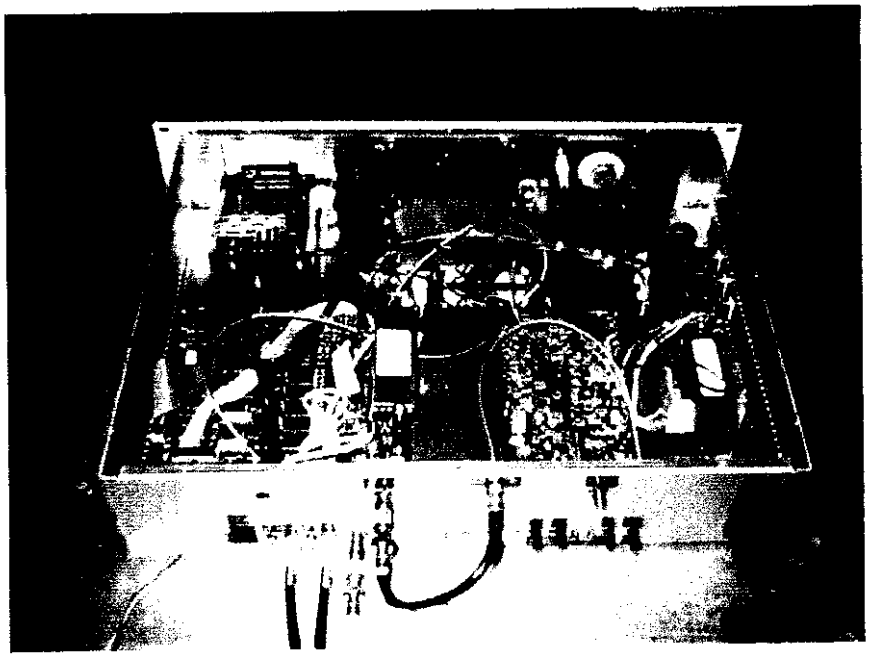

Figure 2 – Top View of EUT with cover removed

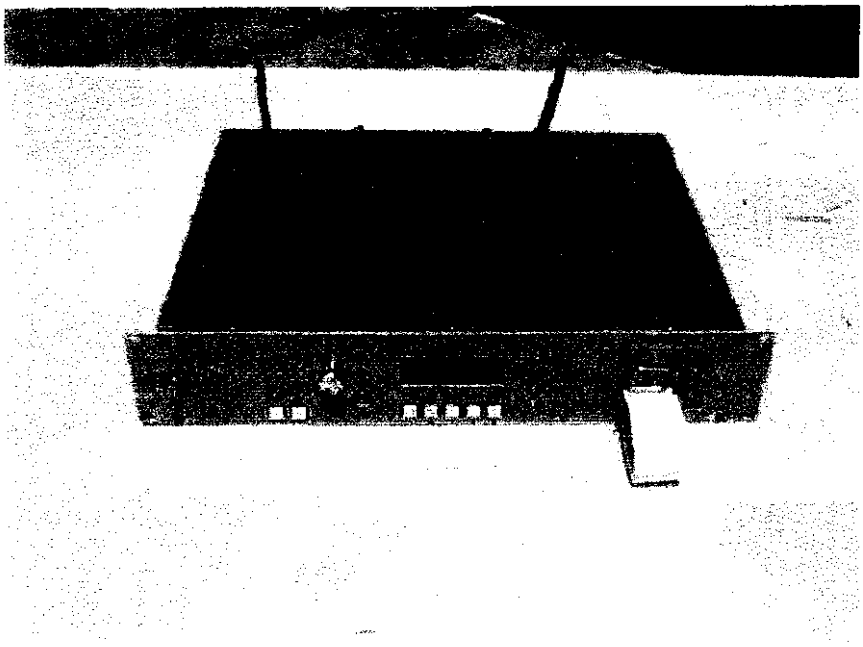

Figure 3 – Front View of EUT

4. Test Results

4.1 Emissions Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 1992 and CISPR 22:1993. Radiated testing was performed at an antenna to EUT distance of 10 meters.

CISPR-22:1993 was published in it's entirety as EN55022:1994, for use within the European Union, in the *Official Journal of the European Communities*, reference 95C 241/02, 95C 325/05).

RheinTexas, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the RheinTexas quality manual. RheinTexas implements these procedures to minimize errors that may occur: The highlights of the procedures are yearly as well as daily calibrations, technician training, and emphasis to employees on avoiding error.

4.1.1 Deviations from Test Methodology

There were no deviations from the test methodology during this test

4.2 Radiated Emissions Measurements

The limits utilized are from CISPR-22:1993/EN55022:1994.

4.2.1 Test Methodology

Whenever possible, and before final measurements of radiated emissions are made on the open-field three/ten meter range, the EUT is scanned indoors at a three meter distance (or one meter distance if necessary) in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in

amplitude, direction and frequency. This process is either repeated, or performed, during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes are obtained. RheinTexas works diligently to ensure that worst case modes, physical arrangement of the test system and associated cabling produce maximum emission levels.

Final radiated emissions measurements were made on the 10 meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 30 MHz to 1000 MHz. When any clock exceeds 108 MHz but less than 500 MHz, the emissions of the EUT are also measured between 1 to 2 GHz using an average detector with the resolution bandwidth set at 1 MHz. For clocks greater than 500 MHz and less than 1 GHz, the emissions of the EUT are also measured between 1 and 5 GHz.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

4.2.2 Test Limits

The tables below list the EN55022 / CISPR-22 radiated emission limits. The EUT to antenna distance used at RheinTexas is always 10m unless otherwise noted. In addition to the CISPR 22 requirements, limits have been imposed above 1 GHz for compliance with the limits found in Part 15 of the FCC rules (47CFR).

Table 2 - CISPR-22 Class A Radiated Emissions

Frequency (MHz)	Limit (dBµV/m)		
	30m	10m	3 m
30 to 230	30	40	50
230 to 1000	37	47	57
≥ 1000[1]	--	49.5	60

Table 3 - CISPR-22 Class B Radiated Emissions

Frequency (MHz)	Limit (dBµV/m)	
	10m	3m
30 to 230	30	40
230 to 1000	37	47
≥ 1000[1]	43.5	54

[1] This FCC Limit actually begins at 960 MHz. The lower limit is used from 960 to 1000 MHz to fully comply with the requirements of CISPR 22.

4.2.3 Radiated Emissions Data

All readings are quasi-peak unless stated otherwise. The pk notation in the receiver reading denotes that this measurement was taken using the peak detector.

Table 4 - Radiated Emissions Data

Emission Frequency (MHz)	Det	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV/m)	EN55022 / CISPR22 Limit (dBuV/m)	EN55022 / CISPR22 Margin (dBuV/m)	Pass/ Fail	Comments
74.235	Qp	V	85	1.0	15.4	8.0	23.4	30.0	6.6	Pass	
131.572	Qp	V	15	1.0	5.2	13.1	18.3	30.0	11.7	Pass	
207.475	Qp	H	175	3.0	9.7	11.5	21.2	30.0	8.8	Pass	
251.923	Qp	V	30	1.0	10.0	14.0	24.0	37.0	13.0	Pass	
368.525	Qp	H	95	3.0	6.2	16.9	23.1	37.0	13.9	Pass	
423.172	Qp	H	50	2.0	6.1	18.2	24.3	37.0	12.7	Pass	
574.172	Qp	V	70	1.0	5.2	21.0	26.2	37.0	10.8	Pass	
630.500	Qp	H	310	2.0	5.4	21.7	27.1	37.0	9.9	Pass	
745.598	Qp	V	110	1.0	5.3	22.7	28.0	37.0	9.0	Pass	
1586.460	Av	V	130	1.0	6.6	29.5	36.1	43.5	7.4	Pass	

4.2.4 Radiated Test Configuration Photographs

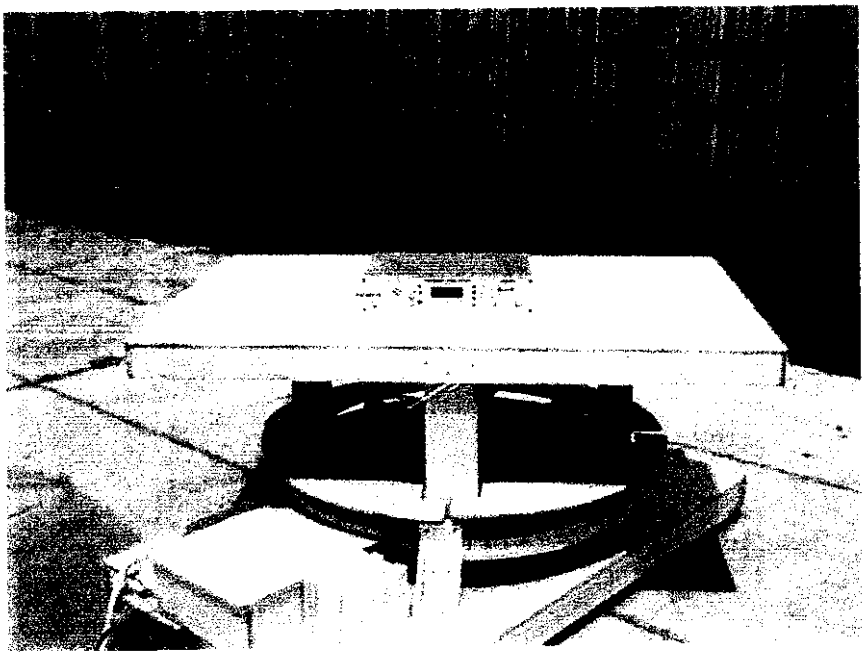

Figure 4 - Radiated Setup (Front View)

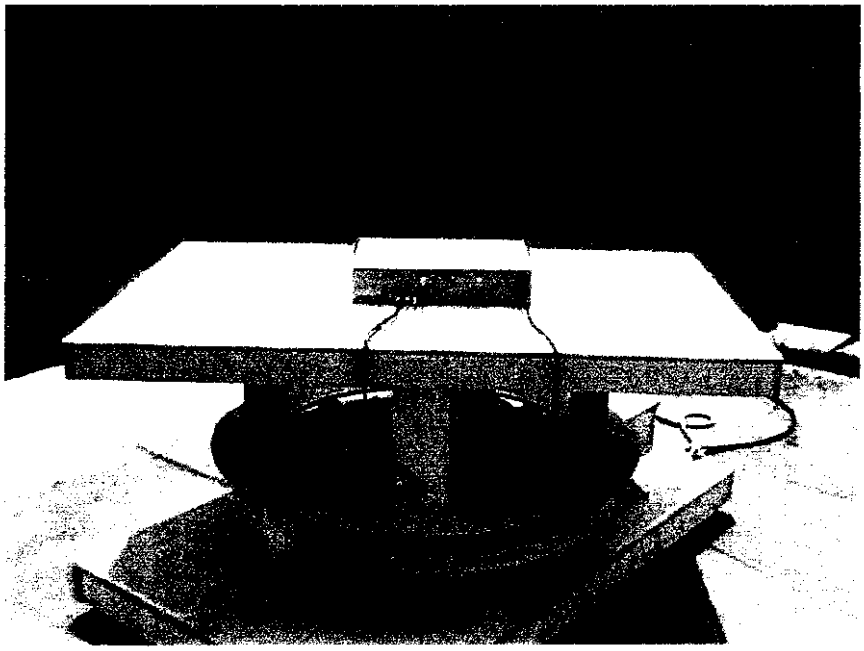

Figure 5 - Radiated Setup (Rear View)

4.3 Conducted Emissions

The limits utilized are from CISPR-22:1993/EN55022:1994.

4.3.1 Test Methodology

The power line conducted emission measurements were performed in a shielded enclosure. The EUT was assembled on a wooden table 80 centimeters high. Power was provided to the EUT through a 50 Ω / 50 μ H Line Impedance Stabilization Network (EUT LISN). The EUT LISN was provided power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolated power for the EUT test peripherals. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line which is bonded to the exterior of the shielded room. The 50 Ω output of the EUT LISN was connected to a high pass filter (>8 kHz), which is then connected to the spectrum analyzer input. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

4.3.2 Test Limits

The tables below list the EN55022 / CISPR-22 conducted emissions limits.

Table 5 - CISPR-22 Class A Conducted Emissions Limits

Frequency (MHz)	Limit (dBμV)	
	Quasi-Peak	Average
0.15 to 0.5	79	66
0.5 to 30	73	60

Table 6 - CISPR-22 Class B Conducted Emissions Limits

Frequency (MHz)	Limit (dBμV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5.0	56	46
5 to 30	60	50

4.3.3 Conducted Emissions Data

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. All emission data is measured in peak mode. Any emissions within 4db of the average limit is then measured with a quasi-peak detector for final measurement. If the quasi-peak value exceeds the average limit but is below the quasi-peak limit, then the signal is re-measured using the average detector.

The quasi-peak measurement is then compared to the quasi-peak limit *and* the average measurement is compared to the average limit. In these instances, both readings must be below their appropriate limits to be considered compliant.

The conducted test was performed with the EUT exercise software running, and the emissions were scanned between 150 kHz to 30 MHz on the HOT SIDE and NEUTRAL SIDE, herein referred to as L2 and L1, respectively.

Table 7 - Conducted Emissions Data, Emergency Alert System (EUT), Hot (L2)

Emission Frequency (MHz)	Detector[1]	Analyzer Reading (dBμV)	Site Correction Factor (dBμV)	Corrected Emission Level (dBμV)	Limit[2] (dBμV)	Margin (dBμV)	Pass/ Fail	Comments
0.151	Pk	40.8	10.7	51.5	55.9	4.4	Pass	
0.800	Pk	26.9	9.3	36.2	46.0	9.8	Pass	
4.432	Pk	27.0	9.5	36.5	46.0	9.5	Pass	
14.380	Pk	31.7	9.9	41.6	50.0	8.4	Pass	
17.960	Pk	32.8	10.2	43.0	50.0	7.0	Pass	
27.220	Pk	27.7	10.6	38.3	50.0	11.7	Pass	

Table 8 - Conducted Emissions Data, Emergency Alert System (EUT), Neutral (L1)

Emission Frequency (MHz)	Detector[1]	Analyzer Reading (dBμV)	Site Correction Factor (dBμV)	Corrected Emission Level (dBμV)	Limit[2] (dBμV)	Margin (dBμV)	Pass/ Fail	Comments
0.155	Pk	39.1	10.7	49.8	55.7	5.9	Pass	
3.200	.Pk	26.5	9.2	35.7	46.0	10.3	Pass	
9.110	Pk	26.8	9.7	36.5	50.0	13.5	Pass	
14.375	Pk	31.7	9.9	41.6	50.0	8.4	Pass	
17.960	Pk	32.8	10.2	42.0	50.0	7.0	Pass	
26.380	Pk	27.3	10.5	37.8	50.0	12.2	Pass	

(1)Pk = Peak; QP = Quasi-Peak; Av = Average

(2)Average limit (QP limit is provided only when a QP measurement fails the Average limit.)

4.3.4 Conducted Test Configuration Photographs

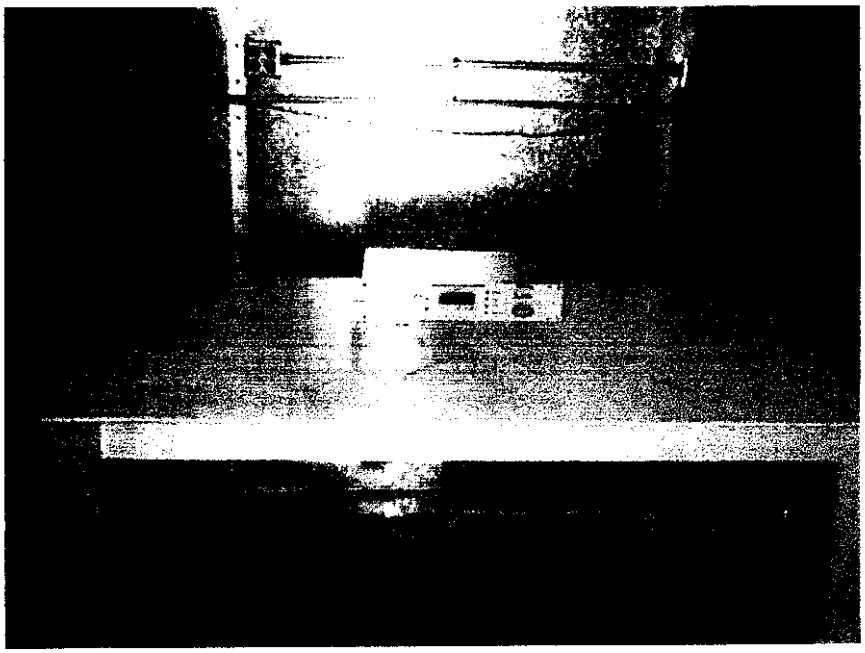

Figure 6 - Conducted Setup, Front View

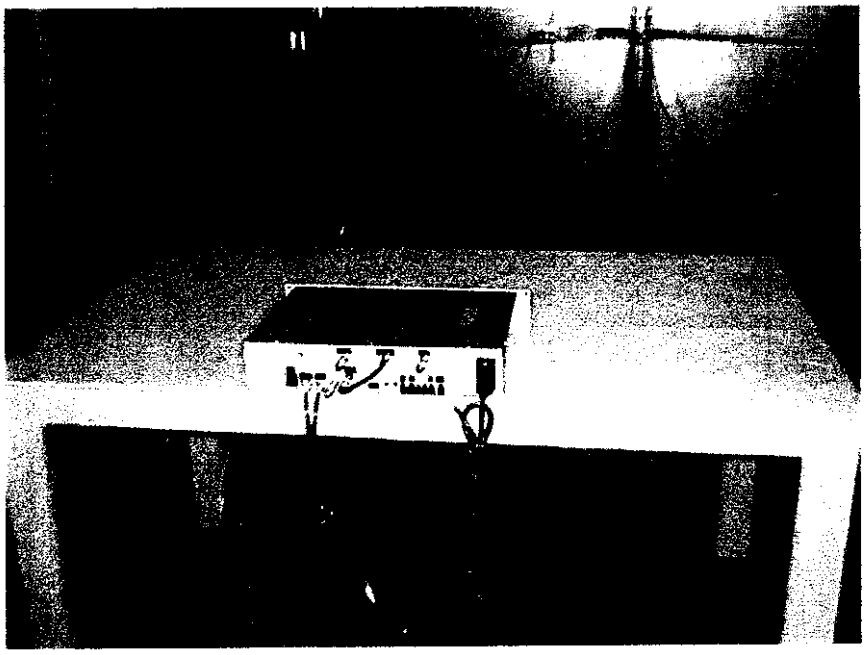

Figure 7 - Conducted Setup, Rear View

5. Test Equipment

The following test equipment was used to perform the radiated and conducted emissions testing. All the equipment is calibrated by competent calibration laboratories traceable to NIST.

The Test column indicates which equipment was utilized to perform the radiated and conducted testing. An "R" in this column indicates that it was used for radiated emissions testing and a "C" in this column indicates that it was used for conducted emissions testing.

Table 9 - Test Equipment List

Test	Manufacturer	Model	Description	Serial Number	Last Cal	Next Cal
Site 1NE						
R	Hewlett Packard	8546A	EMI Receiver	3265A00348 3448A00288	24-Nov-97	24-Nov-98
	RheinTexas	Radiated Cable	Site 1NE	R002	27-Mar-98	27-Mar-99
	Chase	CBL6112A	Bilog Antenna	2149	9-Oct-97	9-Oct-98
Site 2NW						
	Hewlett Packard	8566B	Spectrum Analyzer	2348A05989 2108A00800	1-Oct-97	1-Oct-98
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01859	1-Oct-97	1-Oct-98
	Rhein Tech Labs	PR-1040	Amplifier	N/A	27-Mar-98	27-Mar-99
	RheinTexas	Radiated Cable	Site 2NW	R003	27-Mar-98	27-Mar-99
	Chase	CBL6112A	Bilog Antenna	2150	7-May-98	7-May-99
Site SR1						
C	Hewlett Packard	8567	Spectrum Analyzer	2602A00153 2542A11108	31-Jul-98	31-Jul-99
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01832	17-Oct-97	17-Oct-98
	Solar	9252-50-R-24-BNC	LISN	961023	21-Nov-97	21-Nov-98
	RheinTexas	Conducted Cables	Coaxial Cables	C001	14-Aug-97	14-Aug-98

47 CFR 11.32 EAS Encoder Test Report

Product Tested:

Name: Emergency Alert System
Model: Twister EAS

Prepared for:

Cadco Systems, Inc.
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Tel: (972) 271-3651
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Prepared by:

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REPORT PREPARED BY: Michael Cantwell
RheinTexas, Inc.

Report Number: 9808021-TH
Issue Date: 3 September, 1998

EMC Engineering and Testing Services

47 CFR 11.32 EAS Encoder Conformance Statement

Report Number: 9808021-TH
Product Name: Emergency Alert System
Model: Twister EAS

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. There were no modifications made to the equipment in order to achieve compliance with these standards.

Signature: Michael Cantwell

Date: 3 September, 1998

Full Name: Michael Cantwell, PE

Location: Plano, Texas

Title: Director of Engineering

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1. Executive Summary

The following report for 47 CFR 11.32 compliance of a EAS Encoder is prepared on behalf of Cadco Systems in accordance with the rules of the Federal Communications Commission (47 CFR 11.32). This report was prepared in response to a letter from the Federal Communications Commission (FCC), dated 9 Jul, 1998, reference number 1855 for the Twister EAS, FCC ID ND2EAS.

This report covers testing for the Twister EAS and all testing was performed on 31-Aug-98.

The instrumentation and facilities utilized for the measurements conform with all appropriate standards. Calibration checks are performed yearly on the instruments by a local calibration lab, with traceability to the National Institute of Standards and Technology (NIST).

Testing was performed to verify compliance of theTwister EAS to the following sections of 47 CFR Part 11, EAS Encoder:

Table 1 - Requirements

Section	Requirement
11.32(a)(8)	Spurious Response: All frequencies outside 200 to 4000 Hz shall be attenuated by more than 40 dB
11.32(a)(9)(i)	Tone Frequencies: The audio tones shall have fundamental frequencies of 853 and 960 Hz ± 0.5 Hz
11.32(a)(9)(ii)	Harmonic Distortion: The total harmonic distortion of each of the audio tones may not exceed 5%
11.32(a)(9)(iii)	Minimum Level of Output: The encoder shall have an output level capability of at least 8 dBm into a 600Ω load impedance at each audio tone.
11.32(b)	Operating Temperature and Humidity: 0° to 50°C and a relative humidity up to 95%
11.32(c)	Primary Supply Voltage Variation: Encoders shall comply within an input voltage of 85 to 115% of its rated value

1.1 Modifications to EUT

There were no modifications made.

1.2 Special Accessories

There were no special accessories found necesary as a result of this testing.

2. Test Facility

The facility used to perform the measurements contained in this report was:

Environmental Test Lab
11034 Indian Trail
Dallas, TX 75299-3513
Tel: (972) 247-9657
Fax: (972) 247-9659

The environmental chambers at this facility were utilized to verify the requirements listed in Table 1 and all instrumentation at this facility is calibrated with traceability to NIST.

3. EUT Configuration

3.1 Technical Description

Cadco Systems' Twister Emergency Alert System (TEAS) is designed to provide the user with a simple, low cost, quality solution to the FCC requirement to monitor two audio sources for local, state, and national emergency messages. Cadco has designed the TEAS to fulfill CFR 47, Part 11 requirements while giving the user the functionality necessary to meet local and regional needs.

The TEAS uses a front panel LCD and associated keypad to provide easy to use password protested menus for user/site specific input, alert statusing, message sequencing, and alert activation.

The TEAS monitors two assigned audio inputs. Either the internal National Weather Service Receiver and the internal broadcast band FM receiver may be used for monitoring assignments of and other two audio sources may be connected to the rear panel and used in lieu of the internal receivers. EAS messages are received through the audio inputs, public switched telephone interface, or serial port.

The received audio FSK tones are converted to digital form using a FSK Decoder. The transmitted digital signals representing the EAS codes are converted to analog using a FSK Encoder.

When an EAS message is received it is checked for validity. The microprocessor determines the message validity by comparing repetitive messages and looks for a successful two out of three compare ratio. Invalid messages, those that do not match two out of three times, are discarded without further action. The messages are also compared to FCC guidelines for valid messages.

Valid messages are compared with previously received messages that still have active timer periods. Duplicate messages are discarded. New messages are compared with a list of pre-selected header codes and are either stored for manual processing, automatic delay, or immediately relayed automatically, as determined by the pre-selected header parameters.

The audio portion of the EAS message is digitized and stored ion an internal digital voice storage. The audio is also available at the front monitor speaker and at the back panel audio out.

A base band video message may be relayed. Internal video sync detector circuitry constantly monitors the back panel video input plug and will automatically up convert to IF and pass on any video messages.

Expanded text messages can be compiled and stored internally for automatic relay. Using an internal character generator and IF modulator, text messages are easily transported from the TEAS to a cable headend. Text messages may be compiled using the front keypad, LCD, and program menus. The public switched telephone interface, and /or the RS-232 I/O port.

When an alert is transmitted, the TEAS places the EAS FSK data tones, two tone attention signal, audio message, expanded text message to the character generator/IF modulator section. The output of the IF modulator is a properly sequenced EAS alert modulated at 45.75 MHz, ready for up converting for further propagation.

Audio sources are either stored or live. Live sources are the front panel microphone, two monitored audio source assignments, or the public switched telephone network interface. There are two stored sources. One source stores up two minutes of audio from the two monitored assignments or the microphone. When a message is relayed manual, the user can specify which source the audio will come from.

Assigned audio sources are continuously monitored. Any EAN event will automatically override any other alert.

3.2 Test Configuration(s)

PU = Power Unshielded
PS = Power Shielded
DU = Data Unshielded
DS = Data Shielded

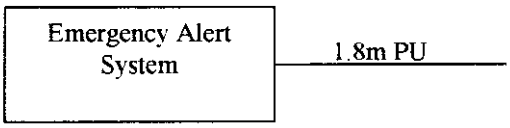

Figure 1 - Block Diagram of System Configuration

The system was configured for testing in a typical fashion (as a customer would normally use it). Antenna connections were terminated into 75Ω.

A list of the equipment under test (EUT) and it's support equipment is found below.

Table 2 - Components in Block Diagram

Description	Manufacturer	Model	Serial No	FCC I.D.
Emergency Alert System (EUT)	Cadco Systems, Inc.	Twister	None	ND2EAS

3.3 Exercise Software

The EUT exercise program used during this testing was designed to exercise the system in a manner similar to a typical use. The software exercised the Emergency Alert System by providing continuous emergency tones.

3.4 Mode of Operation

The EUT was operated with a test software that generated continuous emergency tones.

3.5 Photos of EUT

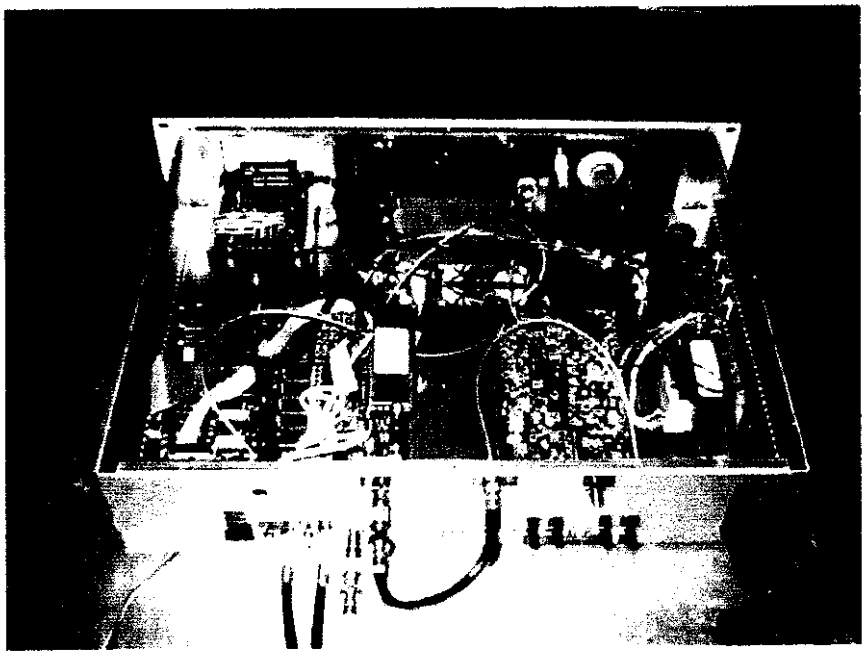

Figure 2 – Top View of EUT with cover removed

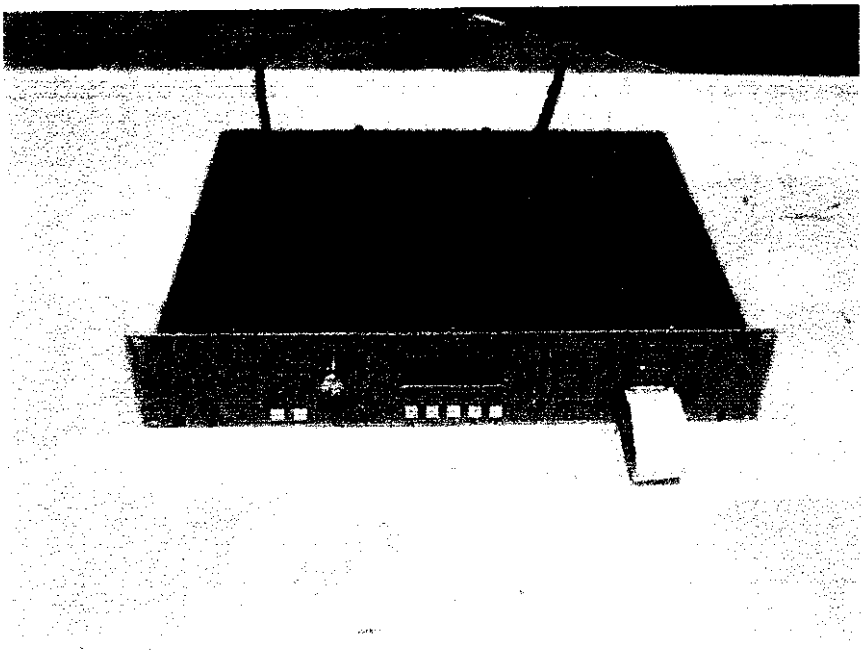

Figure 3 – Front View of EUT

4. Test Results

4.1 Test Methodology

In order to measure the quantities listed in Table 1, an environmental chamber was utilized which varied the temperature and humidity conditions over the required range. Three environmental conditions were chosen:

- 0°C with minimum relative humidity
- 25°C with 50% relative humidity
- 50°C with 95% relative humidity

Under each of the environmental conditions listed above, measurements were performed at 85%, Nominal, and 115% of rated input voltage of the quantities listed in Table 1.

Spurious response was measured using the circuit shown in Figure 4 utilizing an HP8566B spectrum analyzer. The 600Ω resistor was used to provide load matching into the 50Ω characteristic impedance of the spectrum analyzer. The requirement, in 11.32(a)(8), requires that all spurious emissionslocated outside of the audio range of 200 to 4000 Hz be at least 40 dB down from the space or mark frequencies. Being a relative measurement, the delta marker was used to directly measure the attenuation of these spurious emissions.

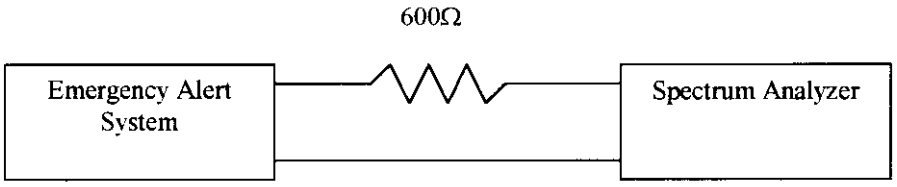

Figure 4 - Spurious Response Measurement Circuit

The tone frequencies were also measured using the above circuit. Software is built into the EAS Encoder to provide continuous tones for measurement.

The harmonic distortion was measured for each tone using an HP339A Distortion Measurement Set. Each tone was terminated into 600Ω for this measurement.

The output level was measured using a Hitachi V-1565 oscilloscope with each tone terminated into 600Ω. The measured votage was converted to dBm using the following formula:

$$P(dBm) = 10 \cdot Log\left[\frac{V^2}{600}(1000)\right]$$

4.2 Test Results

At each of the environmental conditions specified above and performing measurements at an input voltage ranging from 85 to 115% of the rated voltage, the data in the following tables was obtained.

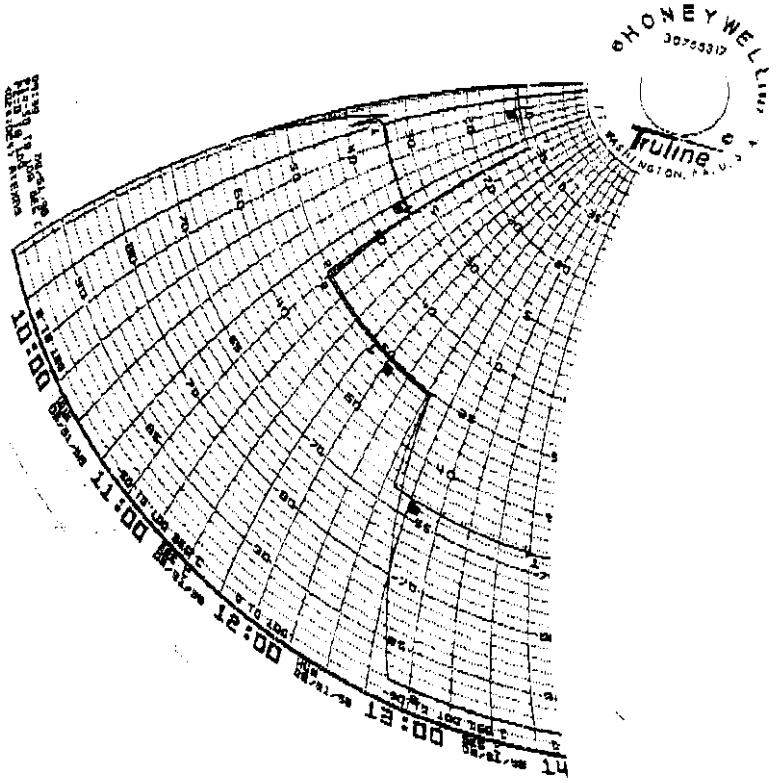

Figure 5 - Temperature & Humidity Chart

Table 3 - Test Data (0°C, Minimum Relative Humidity)

Temp (°C)	Relative Humidity (%)	Input Voltage (V)	Spurious Response (dB)	Tones (Hz)		Harmonic Distortion (%)	Output Level (dBm)
0.3	11.2	102	-49.7	853.0	960.0	0.40	8.41
0.3	11.2	120	-48.9	853.0	960.0	0.41	8.41
0.3	11.2	138	-51.2	853.0	960.0	0.42	8.41

Table 4 - Test Data (25°C, 50% Relative Humidity)

Temp (°C)	Relative Humidity (%)	Input Voltage (V)	Spurious Response (dB)	Tones (Hz)		Harmonic Distortion (%)	Output Level (dBm)
25.1	50.0	102	-57.5	853.0	960.0	0.38	9.07
25.1	50.0	120	-57.2	853.0	960.0	0.38	9.07
25.1	50.0	138	-56.6	853.0	960.0	0.38	9.07

Table 5 - Test Data (50°C, 95% Relative Humidity)

Temp (°C)	Relative Humidity (%)	Input Voltage (V)	Spurious Response (dB)	Tones (Hz)		Harmonic Distortion (%)	Output Level (dBm)
50.1	96.0	102	-55.2	853.0	960.0	0.35	9.11
50.1	96.0	120	-52.7	853.0	960.0	0.36	9.11
50.1	96.0	138	-55.2	853.0	960.0	0.36	9.11

5. Test Equipment

The following test equipment was used to perform the testing detailed in this report. All the equipment is calibrated by competent calibration laboratories traceable to NIST.

Table 6 - Test Equipment List

Manufacturer	Model	Description	Serial Number	Last Cal	Next Cal
Hewlett Packard	8566B	Spectrum Analyzer	2348A05989 2108A00800	1-Oct-97	1-Oct-98
Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01859	1-Oct-97	1-Oct-98
Hitachi	V-1565	Oscilloscope	507165	11-Nov-97	11-Nov-98
Hewlett Packard	339A	Distortion Measurement Set	2025A05128	28-Aug-98	28-Aug-99
Associated Environmental Systems	CNR	Temperature/Humidity Chamber	ETL 041	n/a	n/a
MicriStar	None	Temperature/Humidity Controller	ETL 1195	21-Jan-98	21-Jan-99
Eclipse	None	Temperature/Humidity Recorder	ETL 1196	21-Feb-98	21-Feb-99

LambdaMetrics, Inc.
PO Box 1029
Cedar Park, TX. 78630-1029
Voice and Fax (512) 219-8218
e-mail: benbibb@lambdametrics.com

03 February, 1997

NVLAP
LAB CODE 200122-0

TEST REPORT, FCC COMPLIANCE
> CERTIFICATION §11.34 <

Part 2 Subpart J and Part 15 digital device

TEST REPORT No. LM02037B

L/M PROPOSAL No. 0926A6

CLIENT P/O No. None Issued

Cadco Systems, Inc.
TWISTER Emergency Alert System

FCC ID Code: ND2EAS

NOTICE: (1) This Report must not be used to claim product endorsement by NVLAP, the FCC or any other Agency.

(2) **Cadco Systems, Inc.** is authorized to reproduce this Copyrighted Report only if it is reproduced and distributed in its entirety.

(3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.

Measurements Made For:

GARLAND BROADCAST INVESTORS, INC.
dba **CADCO SYSTEMS, INC.**
2363 Merritt Drive
Garland, TX 75041-6174
Voice: (972) 271-3651 Fax: (972) 271-3654

Equipment Tested:

Manufacturer: Cadco Systems Inc.
Model: TWISTER
Emergency Alert System
Serial No.: None (ID by Lab: FCC01317A)

FCC ID CODE: _____

TEST SPECIFICATION and CERTIFICATION
TWISTER EMERGENCY ALERT SYSTEM

Tested For: Emissions, Part 2 Subpart J and Part 15 digital device, Unintentional Radiator. Immunity, §11.32(d)

Device(s) Tested: TWISTER Solid-state, AC mains powered, telephone controlled Emergency Alert System (EAS), designed to be connected to PSTN, outside antenna, serial communication, and cable TV equipment.

Manufacturer: CADCO SYSTEMS, INC.
2363 Merritt Drive
Garland, TX, USA, 75041-6174

Use of Test: FCC Compliance, Certification, 47 CFR Part 11 FCC submission

Test Requester: Mr. Michael Busby
CADCO SYSTEMS, INC.
2363 Merritt Drive
Garland, TX, USA, 75041-6174
Voice: (972) 271-3651 Fax: (972) 271-3654

Specification:
(a.) FCC Rules 47 CFR Part 11 and Part 15
(a.) **CADCO SYSTEMS, Inc.** Verbal instructions
(b.) ANSI C63.4-1992
(c.) **LambdaMetrics™**. Test Procedure FCC15V-1, 1993

Test Conducted at: **LambdaMetrics, Inc.** NVLAP Accredited Test Facility 200122-0
Cedar Park, TX. (512) 219-8218

Test Date(s): Monday 27 January, 1997 through Monday 03 February, 1997

Test Result: Measurements reported herein indicate that the single sample of **TWISTER Emergency Alert System**, Telephone Controlled EAS, an incidental user of RF signals, and a Part 68 Simple Device is in compliance with the current Federal Communication Commission regulations 47 CFR Part 15 and Part 68 when modified as reported herein. Future identical units may be compliant to the same degree within normal measurement uncertainty. Production sampling is required to maintain conformity.

MEASUREMENT CERTIFICATION

The undersigned hereby certify that this report reflects the actual test conditions and equipment used, and that the conditions and results obtained during this test are accurately documented herein. Further, the Test Engineer certifies that, within the last year, the measurement receiver, amplifier(s), cable(s), attenuator(s),signal source(s) and antenna(s) have been calibrated and are traceable to NIST within the stated transfer tolerances.

Report Written By:	Ben Bibb	Date Signed: 04 Feb 1997
Test Engineer:	Ben Bibb, EMC-001910-NE	Date Signed: 04 Feb 1997
Test Witness:		Date Signed:

1.0 INTRODUCTION

Spurious signal radiation, power line, and antenna conducted signal measurements have been made on the **CADCO SYSTEMS, Inc. TWISTER Emergency Alert System, (EAS)** to determine compliance with FCC rules 47 CFR Part 15 Subpart B, 15.107, 15.109, CLASS-B digital device Limits, 15.111, and the RF immunity of 47 CFR 11.32(d). A Part 68 compliant Test Report, #LM02037A, has been prepared by this test laboratory. The object of this test report is to document the emissions from and RF immunity of the **TWISTER Emergency Alert System**, hereafter called Equipment Under Test (**EUT**).

2.0 TEST METHODOLOGY

This EAS equipment is normally rack mounted in a cable TV head end or broadcast station to provide an audio and video indication of an authorized EAS alert. The system monitors signals from an external antenna connected to the internal FM receiver and a National Weather Service Receiver. Alerts may also be triggered by proper DTMF password validation from the PSTN. It is understood that cable length and installation characteristics will influence radiated emission levels, however, the total power level produced by the configuration tested and documented herein demonstrates the ability of the **EUT** to comply with FCC Class-B emission limits. The table top tests documented herein give a clearer profile of the emission and susceptance characteristics of the **EUT** than would a test conducted in an equipment rack. A specific installation may require some mitigation to prevent interference to co-located sensitive receiving equipment. In problem installations, ferrite suppressers may be placed on offending cables, usually the serial communication lines.

A radiated emission pre-scan over the frequency range of 30 to 1,000 MHz was conducted with the **EUT** set-up and fully operational inside the 1.5 meter (r) shielded test chamber. A list of radiated emissions within 20 dB of the current FCC limit for Class-B digital devices was compiled. Power was supplied to the **EUT** via a ANSI C63.4-1992, Figure 3 LISN during this test.

Radiated emission characteristics over the frequency range of 30 to 1,000 MHz were also measured on an OATS at 3.0 meters (r), documented, and analyzed to determine final compliance with 47 CFR 15.109 radiated emission limits for Class-B digital devices.

Power line conducted signals were measured from the **EUT** over the 0.45 to 30 MHz using procedures and equipment outlined in ANSI standard C63.4-1992 to determine compliance with 47 CFR 15.107 conducted emission limits for Class-B digital devices.

All of the final radiated signal measurements were made at the **LambdaMetrics, Inc.** 3 meter Open Area Test Site in Cedar Park, Texas. Radiated pre-scan and conducted signal emissions were measured in the 1.5 meter (r) Shielded Chamber at this facility. Radiated immunity tests were conducted in the Shielded Chamber using the procedures of IEC 1000-4-3 as applicable to the required immunity tests of Part 11. Part 68 immunity tests were conducted to assure compliance with TIA/EIA Standard 631. Data for this test facility is on file with the FCC Authorization and Evaluation Division at Columbia MD. as covered by 47 CFR 2.948. Last updated October 1996.

During each test the supply voltage was varied from 95 to 135 VAC, the worst (least likely to comply with the regulations) spurious signal reading was always recorded. The outside ambient temperature was 75° ± 5° Fahrenheit and the relative humidity was about 60% during the tests. ANSI Standard C63.4-1992 was used as a guideline for the set-up and those measurements are reported herein. The procedures for measuring Information Technology Equipment (ITE) emissions were followed in as much detail as is applicable to this product. Cables were not bundled per ANSI C63.4 in order to enhance radiated emissions and susceptibility.

On the OATS, the **EUT** was arranged on a 0.8 meter high table at the center of a 1 meter metal turntable which was connected to the OATS conductive ground plane. A 1.5 meter coaxial cable was connected to the 45.75 MHz IF output and terminated at the far end in 75 Ohms. All other cables were unterminated. Photographs of the equipment and test arrangements are provided at the end of this report.

Table 2 lists the measurement equipment employed for this compliance test, the items ✓ed were used for this specific test suite.

2.1 MEASUREMENT UNCERTAINTY, EMISSIONS

The combined standard uncertainty[1] (u_c)for the OATS measurements, the combination of spectrum analyzer, cables, attenuators, pre-amplifier, and antenna factors (±1.5, ±0.3, ±0.4, ±0.6, ±1.2 dB), is 2.07 dB plus a 1.5 dB margin for unidentified terms. *(There are other errors such as mismatch and measurement distributions to be quantified.)*

The major error term for the radiated emission pre-scan is in the M/S chamber, which for this size and type EUT, has been statistically within 10 dB (±5 dB).

For the OATS test this EUT should be 3.6 dB, plus any desired margin, under the stated limit to assure a passing measurement for repeated tests.

To guarantee radiated emissions are under the limit, for this and other reasonably identical units, it is suggested that this EUT should test 6.6 dB below the limit. (3.6 dB plus a 3 dB manufacturing margin.)

For coaxial emission measurements, the combined standard uncertainty is the RSS of the spectrum analyzer, cable, attenuator, pre-amplifier, and filter (or coupler). This uncertainty is (±1.5, ±0.3, ±0.4, ±0.6, (±0.5 dB or 0.75 dB)) ±1.8 to ±1.9 dB. A 5 dB passing (below the limit) margin is suggested to assure consistent conformity with the antenna conducted limits.

For power line conducted emissions, uncertainty from LISN or clamp calibration error, spectrum analyzer, attenuator, HPF, and cable totals ±2.3 dB.

2.2 MEASUREMENT UNCERTAINTY, RF IMMUNITY

RF immunity measurements were performed in a 65 m^3 mode stirred chamber using three different types of antenna, an E-Field Generator from 0.15 to 2.0 MHz, a Biconical from 30 to 200 MHz, and a Log periodic from 200 to 1000 MHz. Each antenna has its own characteristic errors which are further modified by the loading of the M/S chamber. As the large mode paddle rotates the instantaneous field on any given frequency (within the 60 MHz to ~ GHz propagation range of the chamber) will change by about 50 dB. The EUT size and cable arrangement also greatly influences the net effect of the EUT's exposure to RF. A field probe was used to document the peak field uniformity over a 1 meter square area as outlined in EN 1000-4-3. A peak uniform field can be established within the ±3 dB limits of EN 1000-4-3. The field is measured using a fiber optic controlled probe with a traceable accuracy of ±2 dB over the 0.1 MHz to 3.0 GHz range. For the E-Field generator the field was measured between the two extensions in the center of the EUT location, with the EUT removed. During radiated emission testing at 30 MHz and above a computer was used to log the peak field value on each test frequency, this peak value is reported as the applied field. For emissions from the E-Field Generator the field was first measured between the extensions without the EUT, then the EUT was placed between the extensions. The field probe was then moved to a position next to the EUT and the field at that point was reported as the applied field. The field between the extensions with or without the EUT was within ±2 dB on each frequency checked. Measurements of applied fields from 0.15 MHz through 30 MHz could have an error of 2 to 3 dB. Although no formal error analysis has been performed for this measurement suite, experience dictates that the error margin for the immunity test is ±2 to ±4 dB. It is advisable to overtest by a minimum of 3 dB, which was done for this EUT. Results are reported as they are read from the instrumentation.

[1] NIST Technical Note 1297 : 1994 may be consulted for further information on Uncertainty.

3.0 TEST RESULTS, RF IMMUNITY, 0.15 TO 1000 MHz

The RF immunity of this unit was evaluated over the band of 0.15 to 2 MHz at an applied level of 10 Volts per meter and from 88 to 800 MHz at an applied level of 0.5 Volts per meter (0.5 V/m is specified in 11.32(d)). The EUT was unable to respond to an inbound call with an applied field of 3 V/m at 150 MHz, and at 5 V/m on 1.4 MHz. Ferrite beads were added between the rear panel RJ11 and the XECOM phone line interface module as well as to the RS232 connector just inside the rear panel and to the power entrance line just outside the cabinet. This modification improved the immunity to allow operation at 3 V/m from 30 to 1000 MHz. With the modifications installed the EUT is non-responsive at 8 V/m in the VHF band and remained operational at an applied field of 15 V/m over the 0.15 to 2.0 MHz range. An internal power input filter will be required to comply with the conducted limits of TIA/EIA-631.

4.0 RADIATED ELECTRIC FIELD, 30 - 1,000 MHz

Measurements of the radiated field intensity were made over the frequency range using a ADVANTEST R3265 Spectrum Analyzer with associated filters, and preselector. Signal detection was quasi-peak mode except as noted. The CDI B-100 Biconical antenna was used from 30 to 200 MHz and the EMCO 3146 Log Periodic was used from 200 through 1,000 MHz. Pre-scan measurements were made in the Mode-Stirred Chamber at a distance (r) of 1.5 meters from the EUT which consisted of the **TWISTER Emergency Alert System** and associated I/O cables.

A preliminary radiated emission frequency scan was conducted in the test chamber to document the emissions from the complete EUT. The Spectrum Analyzer (S/A) scans (on Pages 10 and 11) shows that several frequencies were found with Radiated Emissions significantly above the instrumentation noise floor. A list of over 20 frequencies with emissions within 20 dB of the FCC Class-B limit was made for further investigation on the OATS.

The EUT was moved to the OATS. A full scan was made from 30 to 1,000 MHz with particular emphasis on the frequencies located during the pre-scan. Emissions closest to the limit were within the 30 to 200 MHz band. At each measurement frequency the receiving antenna height was adjusted between 1 and 4 meters for both horizontal and vertical antenna polarizations in order to record the highest signal emanating from the EUT. The turntable was rotated to optimize the emission readings on each frequency. The spectrum was carefully investigated for possible excessive radiation from the EUT. During this investigation, radiation from the EUT on nineteen (19) frequencies was documented.

Final OATS measurements were made at a distance of 3.0 meters from the face of the EUT. Radiated emissions recorded were the highest (least likely to comply) with the regulations. Pictures of the equipment tested are included on Pages 12 through 17.

The data presented in TABLE 1 has priority over the dynamic (frequency swept) data presented for reference in the plots because the tabular data was taken in the zero sweep mode using the appropriate (120 KHz) resolution bandwidth and with the indicated detector (peak, average, or quasi-peak). The worst (least likely to comply with the regulations) spurious signal reading is always reported.

4.1 RESULTS OBTAINED

The results of the radiated field measurements for this product are presented in tabular form on Page 7. Typical radiated emission spectra are documented graphically, for reference, on Page 10 and 11. The radiated emission measurements made at 3 meters on the OATS show that the **TWISTER Emergency Alert System** tested is in compliance with the maximum allowed radiated emissions for CLASS B digital devices under the current FCC rules.

5.0 LINE CONDUCTED SIGNALS, 0.45 - 30 MHz

Conducted emissions were measured in the 1.5 meter Shielded Chamber using a ADVANTEST R3265 Spectrum Analyzer with associated high-pass filter and 50 uHy LISN constructed IAW ANSI C63.4-1992, Figure 3. Signal detection was quasi-peak mode except as noted.

Primary power to the **EUT** was isolated over the 0.01 to 30 MHz range using the above LISN and arranged IAW ANSI C63.4-1992, Figure 9(a). The LISN RF measurement port(s) were terminated as required and connected to the measurement receiver. The equipment was arranged on the test table 80 cm above the 4m by 5m horizontal ground plane and 40 cm in front of the 4m by 3.5m vertical ground plane. Tests were conducted in different configurations of power feed and the cables were arranged to minimize attenuation of emissions from the **EUT**. The highest signal levels detected were recorded for this report.

5.1 RESULTS OBTAINED

The top of Page 9 indicates graphically the worst case results of the conducted signal measurements for the **EUT**. The test configuration used for this **EUT** complies with the current FCC rules for power line conducted signal tests as outlined in 47 CFR 15.107 for CLASS-B digital devices.

6.0 CONCLUSIONS

As evaluated, this product has fair RF shielding and no power line decoupling characteristics. The EUT tested fails EN 1000-4-4[2] at an applied level of 250V at 5 KHz. The telephone interface becomes inoperable in a mode contrary to 68.312(k). The RF shielding could be improved by more screws in the top cover. The unit presented for testing had two effective (two striped out) cover screws of the four present. Radiated harmonics of the 45.75 MHz IF output signal were found to be enhanced by improper grounding of the top cover. The presence of four secure top retaining screws was simulated for testing. As supplied for testing, radiated emissions exceeded the current limit by about 10 dB at 160 MHz. A single FairRite Products, Corp. bead, P/N 0443164251 applied to the DB9 serial connector at the inside of the rear panel and adequate cover grounding brought radiated emissions into compliance by a satisfactory margin. As supplied for testing, power line RF immunity could not be obtained over the 0.15 to 30 MHz range at 3 V RMS. Adding a shielded and grounded external common mode filter to the IEC power input connector provided immunity to 10 V RMS over the 0.15 to 30 MHz band. To obtain radiated immunity to 10 V/m over the required 0.5 to 2 MHz band, two ferrite beads were required. One bead was placed on the telephone interface connector inside the chassis and one large, FeriShield, Inc. P/N ET33B2000, bead was placed on the power line at the IEC connector outside the cabinet. This large ferrite bead and the capacitance of the external power cable proved that the addition of a line filter would bring the **EUT** into RF immunity compliance. To attain compliance with the EUT tested the following modifications must be implemented:

a) Install FairRite Products, Corp. Bead, P/N 0443164251 on the telephone line as shown,
b) Install FairRite Products, Corp. Bead, P/N 0443164251 on the RS232 line as shown.
c) Install a common mode power line filter.

Care in manufacturing, particularly final assembly and dressing of all interconnecting cables must be exercised to maintain grounds and EMI control features, such as shielding, that were present in this product when tested.

The **CADCO SYSTEMS, Inc. TWISTER Emergency Alert System** was tested and is identified in the enclosed photographs. Compliance may be attained as indicated in this report only with the specified configuration which was tested.

When tested at 3.0 meters, the highest signal level **radiated** from the **EUT** was at 160 MHz at 35.9 dBuV/m (quasi-peak detector), Vertical. This emission is 7.6 dB below the maximum allowed in the FCC regulations for CLASS B digital devices.

The highest **conducted** signal level from the **EUT** was measured at 1.64 MHz on the hot (high, L1) side of the power line at a peak level of 23.8 dBuV This peak signal is 23.2 dB below the maximum allowed in the FCC regulations for CLASS B digital devices.

[2] Not required by FCC. This test was applied while investigating a telephone interface problem.

FCC ID CODE: _____

The FCC emission limits are based on quasi-peak detection. The measurement receiver employed for this test has provided quasi-peak detected data however for the predominantly narrow-band emissions from this product, there is no advantage for QP detection. Peak detection was used to determine the maximum emissions.

Tests indicate that this **EUT** is in compliance with 47 CFR part 15 Subpart B for an FCC Class-B digital devices when ferrite beads as shown herein are included in the design. A power line filter is required to obtain full immunity specifications. Retesting for radiated emission and immunity requirements is recommended after the required modifications are implemented. Further testing may be required to demonstrate compliance if any modifications are made to the product tested. Schematics and/or manufacturing QC documentation was not provided to the test laboratory therefore not evaluated by **LambdaMetrics, Inc.**

OATS E-FIELD MEASUREMENT AT 3 METERS

TEST DATE: 30 January, 1997	SCAN HEIGHT: 1 - 4 Meters
PROJECT: TWISTER EAS	SCAN AZIMUTH: +/- 180°

FREQUENCY MHz	R3265 DETECTOR, 120 KHz RBW SPAN = 0	HORIZONTAL		FCC B-LIMIT 3 meters dBuV/m	VERTICAL	
		MEASURED dBuV/m	LIMIT MARGIN		MEASURED dBuV/m	LIMIT MARGIN
45.8	quasi-peak	U 28.0	-12.0	40	U 36.4	-3.6
45.8	peak	T 20.5	-19.5	40	T 15.0	-25.0
60.0	peak	22.2	-17.8	40	23.5	-16.5
86.1	peak	27.5	-12.5	40	29.4	-10.6
89.8	quasi-peak	28.0	-15.5	43.5	28.3	-15.2
100.0	peak	26.7	-16.8	43.5	28.0	-15.5
119.8	quasi-peak	28.7	-14.8	43.5	29.2	-14.3
128.2	peak	26.3	-17.2	43.5	28.1	-15.4
139.8	peak	27.5	-16.0	43.5	28.7	-14.8
149.7	peak	26.3	-17.2	43.5	29.2	-14.3
151.8	peak	26.0	-17.5	43.5	24.0	-19.5
160.0	**quasi-peak**	**29.7**	**-13.8**	**43.5**	**35.9**	**-7.6**
230.0	peak	32.2	-13.8	46	25.0	-21.0
288.7	peak	32.0	-14.0	46	32.5	-13.5
430.0	peak	25.7	-20.3	46	29.3	-16.7
455.1	peak	27.5	-18.5	46	33.0	-13.0
457.5	peak	32.0	-14.0	46	26.0	-20.0
777.8	peak	23.0	-23.0	46	20.0	-26.0
800.0	peak	26.9	-19.1	46	27.0	-19.0
900.0	peak	25.9	-20.1	46	22.5	-23.5
915.0	peak	27.0	-19.0	46	20.0	-26.0
999.9	peak	nf 24.0	-29.9	53.9	nf 24.0	-29.9

Table 1: Measured Emissions

NOTES: U = 47.5 MHz IF output unterminated.
T = 47.4 MHz IF output terminated in 75 Ohms.
nf = Noise floor of measuring instrument.

FCC ID CODE: _____

> EMC Laboratory Test and Calibration Equipment <				
	Equipment Description	Model #	Serial #	Last Cal
✓	OATS, 3 meter	L/M OATS	N/A	23 Aug 96
✓	Chamber, Test, 1.5 mtr, M/S	1.5MSTC	11223A	23 Aug 96
	Plane, Ground, 1.4m X 1.2m, Cu	801-2-GP	-	09 Oct 95
	Clamp, Cable, 1 meter, Type N	801-4-CLAMP	5124B	09 Sep 95
	Clamp, Radiated Power CISPR 16-13	LMCLAMP2	2165B	16 Aug 95
	Clamp, Current, 0.01 to 100 MHz	91550-2	206	04 Jan 96
	Clamp, Current, 5 HZ to 10 KHz	80i-500S	5070	04 Jan 96
	Clamp, Current, Injection, .01-100 MHz	95236-1	104	04 Jan 96
✓	LISN, 50 Ohm, 50 uHy, 4 Amp	C63492-3-4A	071592B	15 Mar 96
	LISN, 50 Ohm, 50 uHy, 3Φ, 70 Amp	LMLISN70A-X	06126A	13 Jun 96
	LISN, 50 Ohm, 50 uHy, 8 Amp	C63492-3-8A	810-00278	15 Mar 96
	Fixture, Test, ESD, Target, 50 Ohm	1000-4-2 AX-B	06145A	09 Oct 95
	Fixture, Test, Current Clamp, 50 Ohm	CS114CTF	001	22 Mar 94
	Network, CDN, 150 Ohm, M1, Ground	801-M1	50141-M1	11 Apr 96
	Network, CDN, 150 Ohm, M2, DC Power	801-M2	50141-M2	11 Apr 96
✓	Network, CDN, 150 Ohm, M3, AC Power	801-M3	50141-M3	11 Apr 96
	Network, CDN, 150 Ohm, AF2, Unbal.	801-AF2	50141-AF2	11 Apr 96
	Network, CDN, 150 Ohm, T2, Bal.	801-T2	50141-T2	11 Apr 96
	Network, CDN, 150 Ohm, T6, Control	801-T6	50141-T6	11 Apr 96
	Network, CDN, 150 Ohm, S1, Coax	801-S1	50141-S1	11 Apr 96
	Network, CDN, 150 Ohm, K6, K'board	801-K6	50141-K6	11 Apr 96
	Network, CDN, 150 Ohm, S9, DB-9	801-S9	50141-S9	11 Apr 96
✓	Antenna, Biconical, 30-200 MHz	CDI B-100	298	23 Aug 96
✓	Ant. Log periodic, 200-1000 MHz	EMCO 3146	2766	23 Aug 96
	Ant. Dipole Kit, 30-1000 MHz	EMCO 3121C	539	01 Jul 96
✓	Antenna, E-Field, 0.1-300 MHz	EFG-1	03	23 Aug 96
	Ant, Log spiral, 200-1000 MHz	93490-1	4308	20 Jun 95
✓	Mon, Field, W&G 100 KHz to 3 GHz	EMR-20C	B-0074	21 Nov 95
	Mon, Field, W&G 5 Hz to 30 KHz	EFA-1	B-0057	29 Nov 95
	Receiver, EMI, 9 KHz to 1 GHz	EMC-25 MK-III	351	02 Aug 96
	Spectrum Analyzer, 22 GHz	TEK 492BP	B010153	26 Jul 96
✓	Spectrum Analyzer, QP detector, 100 Hz-8.4G	ADVTST 3265	35060162	14 Jan 97
	Spectrum Analyzer, 5 Hz to 50 KHz	HP 3580A-02	A06305	09 Jun 96
	Spectrum Analyzer, QP detector, 9 KHz-1.8G	TEK 2712-12	B011218	16 Mar 96
✓	Preselector, 9 KHz-1800 MHz	TEK 2706	B010106	16 Mar 96
✓	Preamplifier, 100 KHz - 1300 MHz	HP 8447D	A01897	05 Mar 96
✓	Attenuator, 50 Ohm, 3 dB, (2)	CAT-3	12174E	16 Mar 96
	Attenuator, 50 Ohm, 50 dB, 4 GHz	WIE-10350N	521	16 Mar 96
✓	Load, 50 Ohm, 50 Watt, 1000 MHz	603N	157113	16 Mar 96
✓	Directional Coupler / Wattmeter	44AP	26067P	16 Mar 96
	Generator ESD, 330 Ohm, 150 pF	15KV-E	6055A	01 Oct 96
	Generator, Fast Transient Burst	EFT/B-100	3225	09 Sep 95
	Generator, Signal, Wavetek, 1GHz	3010	258354	10 Apr 95
✓	Generator, signal, HP, 2.6 GHz	8660C		05 Oct 96
	Transceiver, 2 meters / 70 cm	YEASU FT-470	96090655	06 Dec 95
✓	Amplifier, 10 Watt, 10-1000 MHz	10W1000	70215	19 Aug 95
✓	Amplifier, 40 Watt, 10 KHz-10 MHz	ENI 240L	352	19 Aug 95
	Amplifier, 80 Watt, 0.05- 150 MHz	AAI 80-AZ	158-02	19 Aug 95
	Amplifier, 280 Watt, 1-30 MHz	IFI 1700	6832463	05 Mar 96
	Generator, Surge, 1.2/50us + _____	CDI-1000i	003212	11 Dec 95
	Filter, Isolated, Line, Backfilter	CDI-IBF	003262	11 Dec 95
	Amplifier, Bridge, 2KW, DC-100 KHz	CROWN 2400	222131	04 Jan 96
✓	Generator, Arbitrary Waveform	HP 33120A	USA 34016250	20 Dec 95
	Oscilloscope, Tektronix, 100 MHz	TDS720	B010609	27 Mar 96
	Oscilloscope, Tektronix, 200 MHz	TDS350	B011355	14 Jan 97

Table 2: Test Equipment List

FCC ID CODE: _____

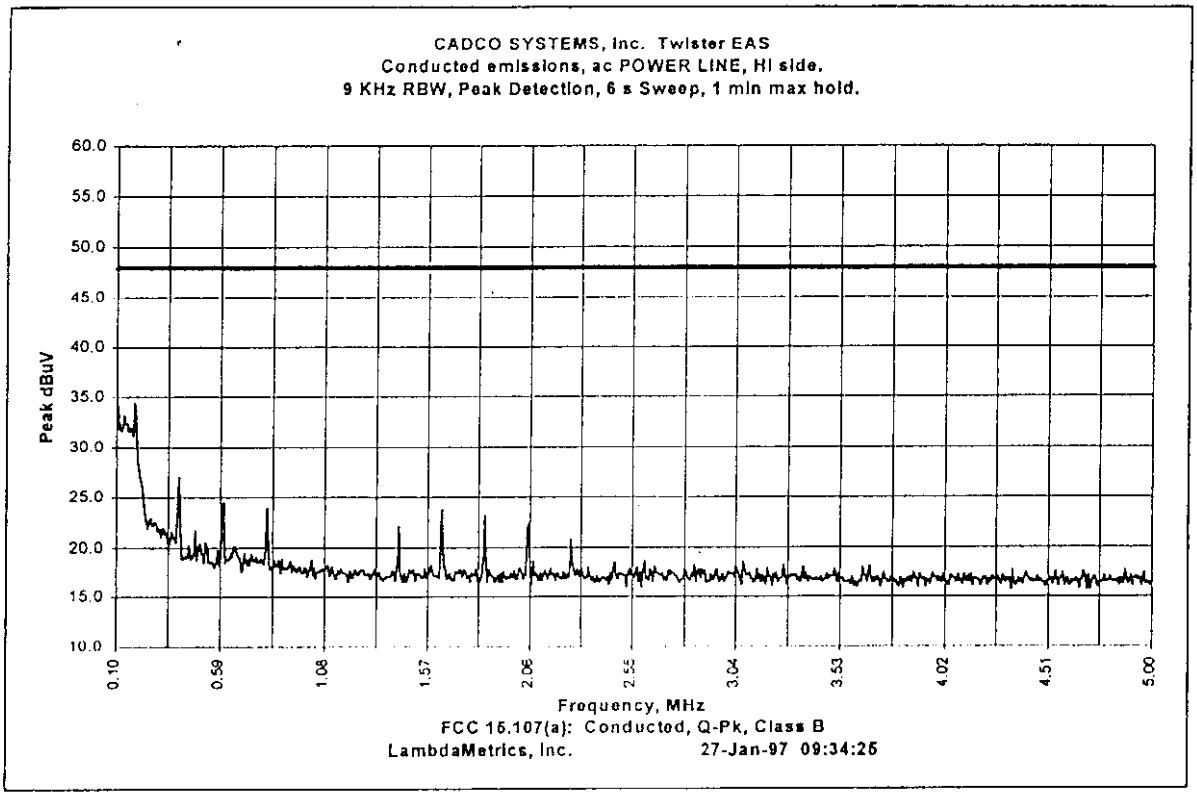

Figure 1: POWER LINE CONDUCTED EMISSIONS

(NOTE: QP limit is shown, Peak detection was used. FCC LF limit is 0.45 MHz.)

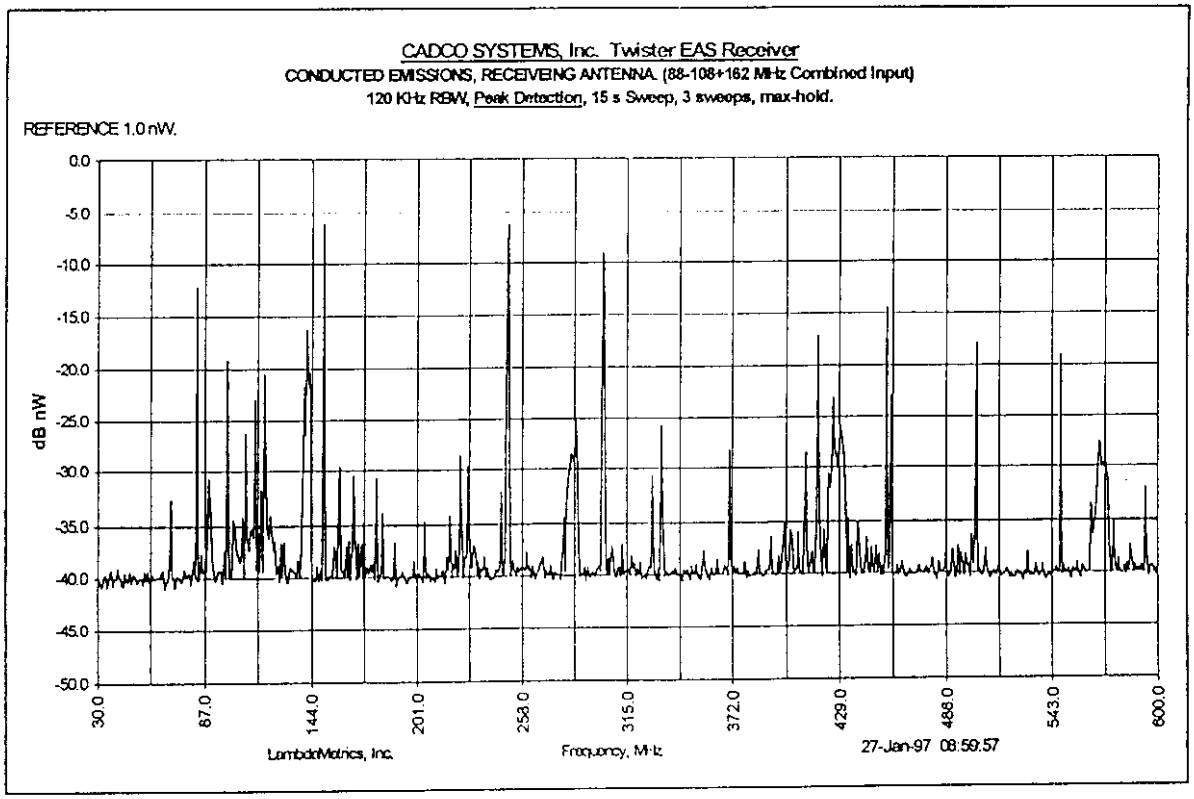

Figure 2: 15.111 ANTENNA CONDUCTED EMISSIONS

(NOTE: Predominant emissions are narrow band. Peak used for identification. Nil after 600 MHz.)

FCC ID CODE: _____

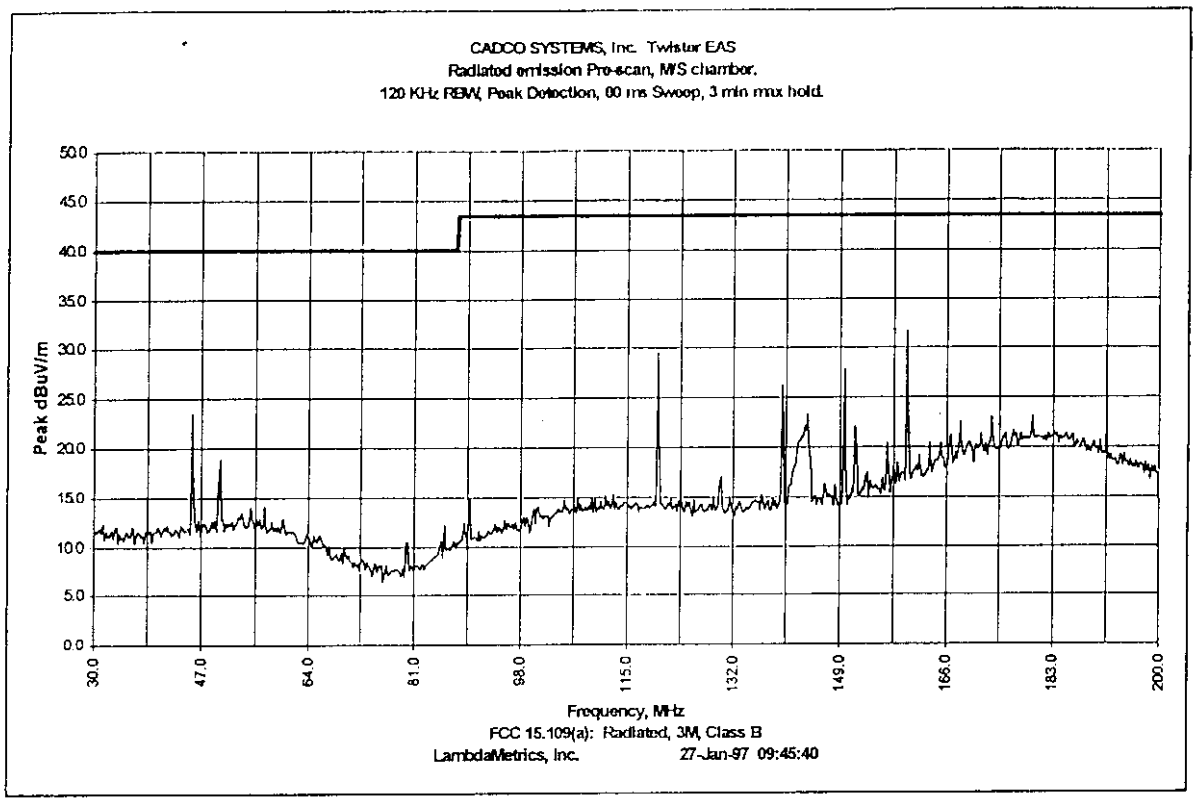

Figure 3: RADIATED EMISSIONS, MODE STIRRED CHAMBER
(NOTE: EUT Powered, NO I/O Cables Attached.)

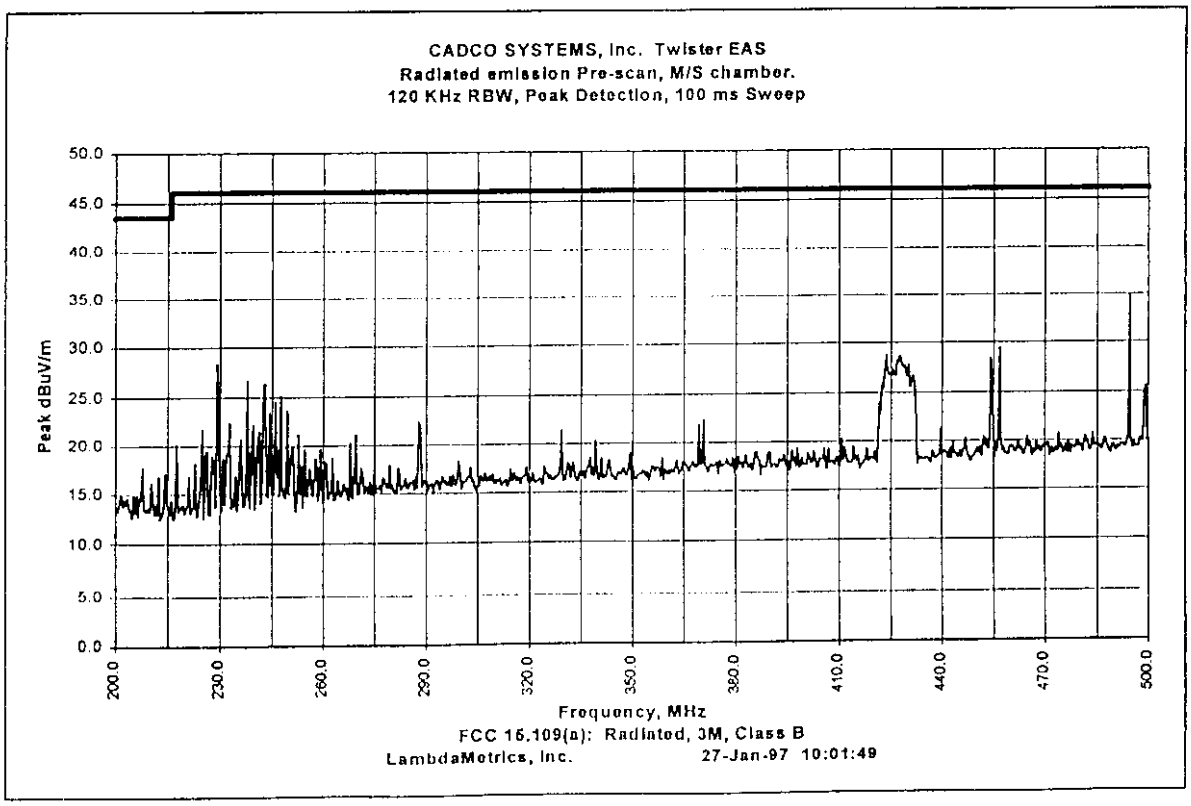

Figure 4: RADIATED EMISSIONS, MODE-STIRRED CHAMBER
(NOTE: I/O cables are connected.)

FCC ID CODE: _____

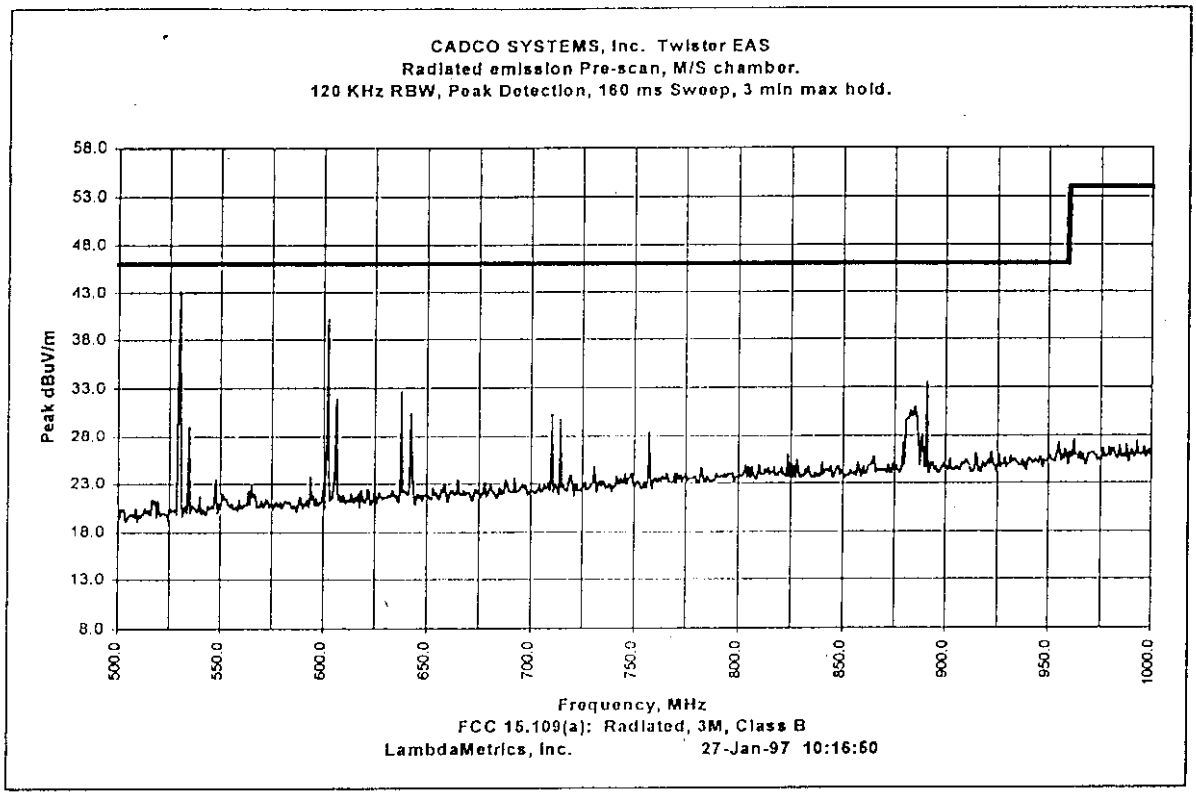

Figure 5: RADIATED EMISSIONS, MODE-STIRRED CHAMBER
(NOTE: TV ingress into chamber via telephone line.)

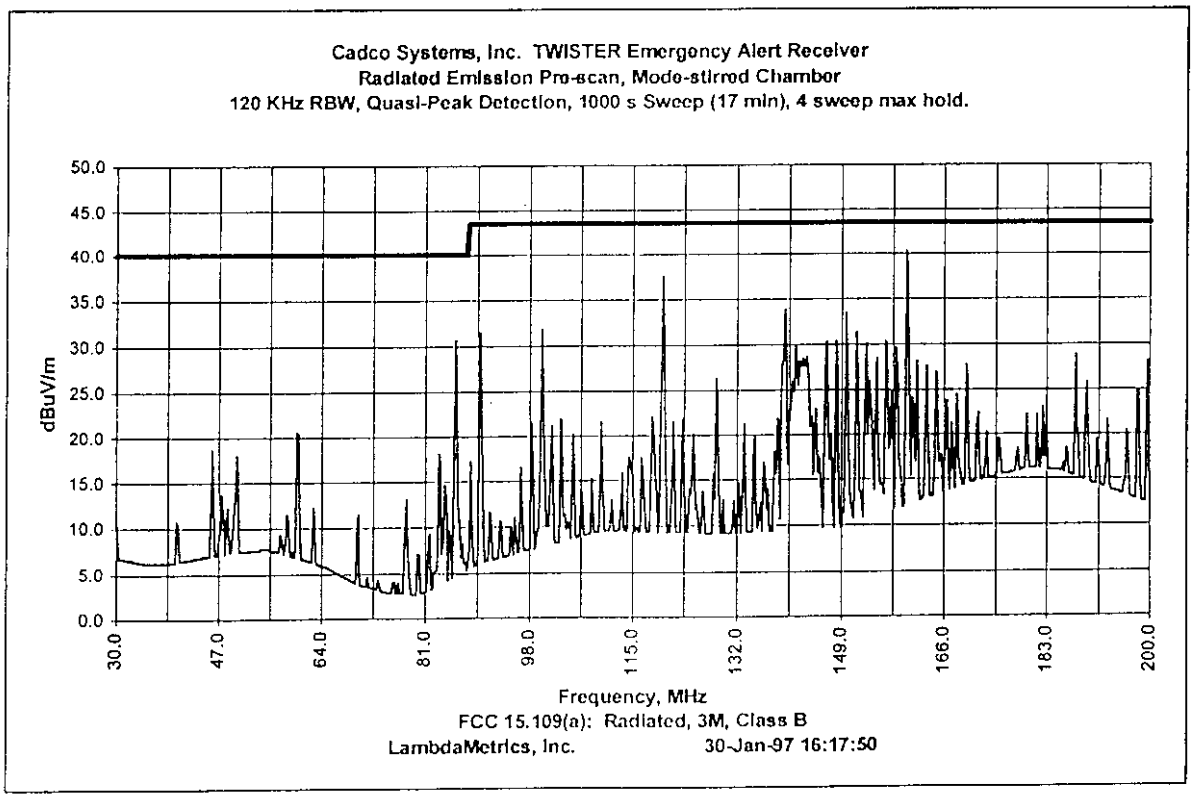

Figure 6: RADIATED EMISSION, WORST CASE, Quasi-peak detection